
Exercise During the Childbearing Year

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Abstract

Many women wish to continue to pursue an active lifestyle during pregnancy, while the pregnancy itself may provide the motivation for other more sedentary women to begin an exercise program for the sake of improved health/fitness. Also, female competitive athletes, upon becoming pregnant, may wish to continue sports performance and require careful monitoring to assure maternal-fetal safety. This review is designed to assist the perinatal educator who is in the position to advise the pregnant patient on the risks and benefits of physical activity during the childbearing year and provide suggestions for developing individualized exercise programs.

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Pregnancy, recovery from childbirth, and lactation occur over at least 12 months and constitute a unique period during which a woman may wish to exercise for health/fitness, recreation, or sport. Mild exercises aimed at strengthening muscles taxed by pregnancy or giving birth have traditionally been part of prenatal education classes; indeed, for decades walking has been encouraged for pregnant women. More recently, concerns have arisen about the safety of more robust exercise during pregnancy, including hyperthermia, fetal distress, miscarriage, and maternal injury. However, the risk is low and there are many potential benefits of more vigorous exercise for the mother during this time. These include weight control, physical fitness, active recreation, and positive mental health benefits. Perinatal educators may play a key role in providing information and supporting safe and effective exercise programs, as well as helping

to monitor progress of their pregnant clients. This discussion provides a review of documented research for those professionals who work with women who choose to be active during their pregnancies. Its purpose is to suggest ways of developing a safe and effective individualized exercise prescription and monitoring program for women during the childbearing year.

History of Physical Activity During Pregnancy

For much of recent history, pregnant women were treated as if they had an illness and were subjected to a state of confinement. They were advised to relax, avoid strenuous exertion, and minimize stretching and bending for fear of strangling or squashing the baby. More recently, it was considered acceptable to continue to exercise if the woman was active prior to becoming pregnant, but experts advised against initiating any exercise program during pregnancy. Generally, two schools of mutually incompatible thought existed. The conservative faction, mostly comprised of health care providers, felt exercise was potentially harmful and recommended a restrictive, cautious approach to physical activity during pregnancy. The liberal group was represented by women who were active during pregnancy, perceived no adverse consequences, and felt exercise improved the course and outcome of their pregnancies. Today, a significant number of pregnant women are active and want to maintain a vigorous exercise program. A brief review article by O'Neill, Shnier, Cooper, Hunyor, and Boyce (1990) is recommended for those interested in reading more on the history of exercise during pregnancy.

As health care providers' ideas about prenatal exercise began to change, the American College of Obstetrics and Gynecology published its first guidelines for exercise during pregnancy (ACOG, 1985). These appeared in 1985 and, albeit conservative, were at least a starting point for women who wanted to be physically active during pregnancy and provided guidance for the health care professionals who would advise them. The ACOG guidelines were criticized by some for lacking hard data to support the recommendations. For example, the guidelines contained very specific exercise heart rate and exercise duration cutoffs of 140 beats/minute and 15 minutes, respectively. Some women and their fitness advisors viewed the guidelines as too restrictive and found them a source of frustration rather than assistance.

Since the first ACOG guidelines appeared, a considerable shift has occurred in the attitudes of professionals towards exercise and pregnancy, and a body of research has appeared that helps support more liberal guidelines. Continuing or even beginning an exercise program during pregnancy is now generally viewed as safe. In 1994 the ACOG introduced more flexible guidelines that reflected this change (ACOG, 1994). While they may still be regarded as conservative by some, these guidelines are a basic source of information for the previously sedentary woman who wants to begin an exercise program. They also offer guidance for those wishing to continue existing exercise programs. Other professional organizations and noted researchers in the field have also published guidelines for exercising during the childbearing year (American College of Sports Medicine, 1995; Canadian Society for Exercise Physiology, 1996; Clapp, 1998; Royal Australian College of Obstetricians and Gynecologists, 1994). Awareness of these guidelines is important not only for advising women of safe exercise programs but also for knowing the standards that may be applied in medical/legal situations. Table 1 combines key points of agreement and summarizes these guidelines.

Perinatal educators need to be aware that there are situations for individual women which contraindicate exercise. These are noted in Table 2 with some conditions being generally considered absolute contraindications and others requiring careful evaluation, monitoring, and prescription based on the individual situation. The four most significant contraindications to beginning an exercise program or resuming one are (1) physical injury, (2) an acute bout of illness or a serious chronic disease, (3) onset of persistent or recurrent abdominal or pelvic pain, and finally (4) abnormal or heavy vaginal bleeding. Other possible limitations, potential risks, and special concerns will be addressed.

Benefits of Exercise

Exercise offers many potential benefits for women during pregnancy. Those most frequently cited are listed in Table 3; the supporting research is documented below.

Healthy Body Weight. Maintaining a healthy body weight and avoiding excess fat accumulation are frequently stated goals of women who choose to exercise during pregnancy. Overall weight and fat gain was signif-

Table 1 Guidelines for Exercise During Pregnancy in Healthy Women*

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- Obtain medical clearance before participation.
 - The exercise prescription should be individually based.
 - Regular mild to moderate exercise routines are preferable to intermittent activity.
 - Gradually increase exercise intensity and duration if previously sedentary.
 - A maximum heart rate limit up to 155 b/min is recommended, although levels of intensity higher than this can be prescribed on an individual basis.
 - Walking, cycling, swimming, low-impact aerobics, and stretching are recommended activities.
 - Do not exercise in the supine position after the 4th month. Don't stand motionless for long periods of time.
 - Stop exercising when fatigued and do not deliberately reach a point of exhaustion. Get plenty of rest.
 - Do not perform exercises that could cause a loss of balance.
 - Eat an additional 150-300 calories a day and drink plenty of fluids before, during, and after exercise. Emphasize complex carbohydrates to replace muscle glycogen stores.
 - Do not exercise when it is hot or humid or when febrile. Wear clothing that is cool and allows ventilation.
 - Bouncing, jerky movements should first be reduced and then avoided during the 3rd trimester.
 - Avoid high-altitude activities and scuba diving.
 - Participation in competitive sports is acceptable during the first 16 weeks of pregnancy if risk is accepted, but contact sports should be avoided thereafter.
 - Lifting light to moderate weights is encouraged to develop or maintain strength, but the valsalva maneuver should be avoided.
 - Know the warning signs to discontinue exercise and consult with prenatal health advisor.
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* Adapted from Clapp (1998), CSEP (1996), ACSM (1995), ACOG (1994), and RACOG (1994).

Table 2 Contraindications to Exercise During Pregnancy*

Absolute Contraindications	Relative Contraindications
Severe cardiovascular, respiratory or systemic disease	History of repeated (3 or more) miscarriage or premature labor
Uncontrolled hypertension, diabetes or thyroid disease	Diabetes
Ruptured membranes or premature labor	History of rapid labor or poor fetal growth
Persistent bleeding after 1st trimester	Early pregnancy bleeding
Incompetent cervix	Sedentary lifestyle with very poor fitness
Preeclampsia or toxemia	Breech presentation after 28 weeks
Multiple pregnancy (triplets, etc.)	Palpitations or arrhythmias
Poor fetal growth	Anemia or iron deficiency
	Extreme over- or underweight

* Adapted from Clapp (1998), CSEP (1996), ACSM (1995), ACOG (1994), and RACOG (1994).

Table 3 Benefits of Exercise During Pregnancy

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- Maintain healthy body weight and avoid excess fat accumulation
 - Maintain or improve cardiovascular fitness, muscular strength and endurance, and flexibility
 - Decreased musculoskeletal complaints such as back pain
 - Decreased minor discomforts of pregnancy
 - Improved posture and body mechanics, which may improve coordination, balance, and body awareness
 - Reinforced principles of breath awareness and relaxation
 - Prevention and treatment of problems associated with gestational diabetes, hypertension, and preeclampsia
 - Stress reduction and enhanced self-image
 - Possible easing of labor with fewer complications of delivery and faster postnatal recovery
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icantly lower in a group of experienced exercisers who were active both before and during their pregnancies compared to a control group of previously active women who quit exercising before or during early pregnancy (Clapp & Little, 1995a). Other studies of women who exercised during pregnancy, but to a lesser degree, have not shown a difference in body weight or composition compared to controls (Sternfeld, Quesenberry, Eskenazi, & Newman, 1995; Hatch, Shu, McLean, et al., 1993).

Cardiovascular Fitness, Muscular Strength, and Endurance. Cardiovascular fitness, muscular strength,

and endurance are maintained or improved in women who exercise while pregnant. This is important because pregnancy increases blood volume, which in turn increases heart rate, stroke volume, and cardiac output. All studies that have examined the subject have concurred that regular exercise avoids the problems associated with disuse and improves maternal fitness (Clapp & Little, 1995b; ACOG, 1994). Less is known about the effect of resistance training on pregnancy, but existing information indicates it does increase muscular strength and endurance without negatively affecting fetal or maternal well-being (Clapp, 1998; Pirie & Herman, 1995; Pirie, 1987).

Improved Posture. Improving posture and body mechanics of pregnant women through exercise classes was shown to decrease the incidence or severity of lower back pain, which is so prevalent during pregnancy (Ostgaard, 1996). Although studies have not shown that exercise can totally eliminate either lumbar pain or posterior pelvic pain (the two most common types of back pain during pregnancy), Perkins, Hammer, and Loubert (1998) note that exercise can help provide relief of symptoms for many women, especially for those suffering from lumbar pain. Exercise in the water can be therapeutic in this regard. A recent study shows that women who participate in a water exercise class have reduced symptoms of back pain during late pregnancy and missed fewer days at work compared to a control group (Kihlstrand, Stenman, Nilsson, & Axelsson, 1999).

Prevention or Treatment of Pregnancy-Induced Complications. Gestational diabetes is a complication of pregnancy for some women. Exercise has been shown to be effective in either preventing or treating problems of gestational diabetes in those predisposed. The responsible mechanisms are that glucose tolerance and insulin sensitivity is improved, while muscle and liver glycogen

storage is enhanced and, thus, the incidence of hypoglycemia is reduced (Bung, Artal, Khodiguan, & Kjos, 1991). It is important to prevent maternal hypoglycemia because it could cause reduced fetal glucose levels, which can lead to fetal growth retardation (Wolfe, 1993). The exercise of a woman who has already developed gestational diabetes will need careful individual monitoring by an experienced, qualified professional.

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One study has indicated that the rate of pregnancy-induced hypertension and preeclampsia may also be lowered in women who engage in regular physical activity compared with those who are sedentary (Marcoux, Brisson, & Fabia, 1989). More study on this important complication is needed.

Active women may possibly have fewer spontaneous miscarriages (Latka, Kline, & Hatch, 1999). Traditionally, pregnant women have been directed to wait until the second trimester to begin an exercise program if they were not previously active. The thought behind this directive was to avoid risking miscarriage during a vulnerable period. However, no studies have shown either an interference with the ability to become pregnant or increased rates of complications (such as spontaneous abortion or congenital deformities) in women exercising during the conception phase or early in pregnancy. Residual concerns in this matter have lead experts to continue to advise caution in this respect until more research is available (Wolfe, Brenner, & Mottola, 1994). Until greater supportive evidence exists about exercise in early pregnancy, the risk of litigation makes many care providers cautious about prescribing exercise.

Relief of Minor Discomforts. Some evidence supports the belief that exercise may assist with many of the minor discomforts of a normal pregnancy. Women who exercise during pregnancy may have reduced incidence of constipation, improved bladder control, decreased incidence of varicose veins, improved sleep, less heartburn, and fewer leg cramps (Wolfe et al., 1994). Anecdotally,

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some women have found that a 3- to 5-minute exercise period helps alleviate symptoms of morning sickness.

Easing of Labor. Studies by two researchers, Clapp (1998) and Sternfeld et al. (1995) show a nonsignificant trend for earlier onset of labor and delivery at term, shorter labor, and lowered rates of complications during delivery (such as Cesarean section, use of forceps or labor-inducing drugs, vaginal tears, and fatigue). Also, no increase in fetal cord entanglement was noted. In these studies, the babies of women who exercised had higher Apgar scores while their mothers experienced faster recovery following parturition. Clapp (1998) has also shown that those who remain active throughout their pregnancies may find it easier to return to pre-pregnancy physical condition following childbirth.

Psychological Benefits. Exercise is also known for offering many psychological as well as physiological benefits. Potential psychological effects of exercise include improved mental well-being, which can lead to a decrease in the incidence of depression and anxiety, an increase in self-esteem, an enhanced body image, and a greater sense of control (Horsley, 1998; Wolfe et al., 1994).

In summary, recent research supports the belief that active prenatal exercise can bestow numerous benefits to mother and/or baby. The strength of the research varies across benefits, and additional research is warranted. It is encouraging to note that this growing body of research generally points in the direction of benefits.

Risks of Exercise

Popular concern warns that the risks of exercise may cause premature labor, abortion, or congenital deformities. There are no reports documenting that regular exercise per se increases the occurrence of maternal or fetal injury in a healthy woman with a normal pregnancy. She can be physically active without endangering herself or her fetus. Nevertheless, each woman must be informed of the potential risks of exercise and warned of any associated problems so that she can make an educated decision regarding her exercise participation. The dangers and warning signs associated with risks are discussed below.

Risks in Stressful Work Environments

Occupational hazards inherent in physically demanding jobs must be considered. For example, experts caution against engaging in shift work that requires persistent heavy workloads including strenuous lifting, long hours of standing, or exposure to loud noise or vigorous vibrations (Depken & Zelasko, 1996). However, the risk for abnormalities in birth outcomes from physically demanding work is not clear; many potential biases and sources of error exist in available studies. In-depth reviews of the risks in stressful work environments are available (Luke, Mamell, Keith, et al., 1995; Simpson, 1993; Hatch & Stein, 1991). In summary, although a physically stressful work environment has some potential overlap with physical stress due to exercise, the research is not well developed enough at this time to generalize between the two topics.

Risks for the Fetus

Risks of Hypoxia. Exercise may cause decreased uteroplacental blood flow, which in an extreme situation may lead to accompanying fetal hypoxemia and/or hypoglycemia. During sustained exercise, there is decreased splanchnic blood flow; however, the trained pregnant woman's placenta has exhibited an expanded absolute blood volume and oxygen extracting capability, thereby providing adequate fetal nutrition (Clapp, 1998; Wolfe, 1993). Problems of such fetal distress, as determined by fetal heart rate (FHR) and fetal movement, are rare and have been shown to occur only in women who were unfit and engaged in episodic, vigorous exercise during pregnancy (Artal & Posner, 1991). In addition, specific concerns exist with high-altitude recreational activities above 9,000 feet, which could result in hypoxemia and carry uncertain fetal and maternal risks. It is best to stay below this altitude, especially for women who normally live near sea level. Scuba diving, which relies on compressed gas for breathing, should probably be avoided (Artal & Buckenmeyer, 1995). If this activity is performed, dives should be limited to depths of 12-16 feet to prevent diffusion of nitrogen into the tissues (Clapp, 1998). The authors of the present paper recommend that it would be prudent for the woman who wishes to dive during pregnancy to limit herself to skin diving on or near the water's surface.

Risks of Hyperthermia. The greatest threat of fetal defects caused by high temperature occurs during the first trimester. Intense exercise in hot and humid conditions can elevate core temperature to between 102-104 degrees Fahrenheit. Hyperthermia to this degree has been correlated with accompanying neural tube developmental defects and teratogenesis in early pregnancy (McMurray & Katz, 1990). Pregnant women have improved heat-dissipating ability, which is enhanced further with exercise conditioning. Furthermore, women allowed to exercise at a self-selected pace have not experienced dangerously high body temperatures (Stevenson, 1997a). There has been no documented increase in neural tube or other birth defects among pregnancies of women who continue to exercise, even vigorously, during early pregnancy (ACOG, 1994). Nevertheless it is advisable for pregnant women to avoid exercise in hot, ambient conditions or at an intensity or duration that causes the body temperature to rise above 101.6 degrees Fahrenheit (ACOG, 1994).

Hormonal Stress. Exercise is known to cause surges in certain hormones such as the catecholamines and prolactin, which may cause premature increases in uterine contractility. Fortunately for women accustomed to exercise, training results in a blunting of these responses and studies have not shown a correlation between vigorous exercise and early spontaneous abortion or premature labor onset (Clapp, 1998). Nevertheless, women with a history of multiple miscarriage should be cautious and have all exercise programs approved by their health care provider.

Fetal Growth. Exercise may also result in decreased infant size and body weight. This is known to occur in those who maintain vigorous activity throughout their pregnancies. The infants of these mothers were leaner but no less healthy than their fatter counterparts born to more sedentary mothers (Clapp & Capeless, 1990). Long-term outcomes remain largely unstudied. A recent 1-year, follow-up study indicated that the offspring of 52 exercising mothers were not clinically significantly different in body weight and fat or in observed performance on psychomotor or mental tasks compared to the infants of 52 control subjects (Clapp, Simonian, Lopez, Appleby-Wineberg, & Harcar-Sevcik, 1998).

Risk of Trauma. Blunt or penetrating trauma to the abdomen could result in fetal damage. This may occur in women later in pregnancy when the fetus is anterior to the pelvis and less protected. Women in competitive sports where this is a risk may choose to curtail their participation. They should be warned that they may become more prone to falls, since their balance alters as their pregnancy progresses. Table 4 summarizes activities of concern for pregnant women.

Risks for the Mother

Strains and Sprains. Many fear strenuous weight-bearing exercise, especially during late pregnancy or the early postpartum period, damages ligament and connective tissue and, in turn, causes long-term joint instability. No evidence beyond clinical anecdotes supports this view. Pregnant women need to be especially cautious with ballistic exercise (high-velocity musculoskeletal bouncing or jerking movements) since it may increase the risk of orthopedic problems, including soft tissue injuries (e.g., increased risk of strain and sprain). This is due to hormonal changes such as the increase in relaxin and progesterone, which may cause increased laxity. Pre-existing sacroiliitis, symphysitis, and lumbar facet joint inflammation may also be exacerbated by strenuous exercise. If a pregnant woman experiences considerable posterior pelvic pain or pubic symphysis pain aggravated by exercise, she may be required to limit high-impact activities and moderate weight-bearing exercise with uneven loading forces. She should be referred to a profes-

Table 4 Sports Activities of Concern for Pregnant Women*

High-Risk Contact Sports	Other High-Risk Sports
Ice and Field Hockey	Gymnastics
Boxing	Horseback Riding
Wrestling	Ice and In-line Skating
Football	Alpine and Water Skiing
Soccer	Hang Gliding
Rugby	Board and Body Surfing
Competitive Basketball	Vigorous Racquet Sports
	Power Lifting
	Scuba Diving
	Rock Climbing
	High-Altitude Activities

* Adapted from Wang and Apgar (1998).

sional who can diagnose the specific cause and advise her accordingly. The distinction between posterior pelvic pain, which may be related to pelvic joint laxity, and lumbar pain, which more closely resembles backache that occurs at times other than pregnancy, is important since activity restrictions are different. The subject of back pain during pregnancy has been thoroughly reviewed by Perkins et al. (1998) and Mantle (1994).

Need for Support. Lower abdominal, pelvic, and/or breast discomfort may occur during exercise in late pregnancy. The key to the first problem is to provide upward lift and mild compression on the lower abdomen. This relieves pressure on the bladder, lifts the womb off of the pelvic bones, and stabilizes the womb. Commercial maternity abdominal support belts are available, but a wide elastic bandage usually works well as a preliminary trial and may be all that is required to relieve the pain. Breast support is achieved by compression rather than lift and separation. Commercial maternity sports bras are now available, but if further support is needed, two sports bras worn together can help in large-breasted women. An elastic bandage can also be wrapped over the breasts between the two bras, if even more support is needed. If elastic wraps are used, they must be applied with caution so as not to be too tight or restricting.

Hypoglycemia. Hypoglycemia can occur as a result of low-intensity, long-distance exercise. It can become an impending problem as the pregnancy progresses as the metabolic needs of pregnancy increase. Pregnant women also utilize carbohydrates to a greater extent during exercise than nonpregnant women. If the woman feels dizzy, faint, or tired during the late stages of exercise or in the recovery phase, she can be taught to check her glucose using a blood sample from her finger. Levels below 60 mg/dL (or more than a 25-point drop from resting levels) are too low (Clapp, 1998). Consumption of carbohydrate during exercise (such as a sports drink or dried or fresh fruit) and immediately following (e.g., granola bar, fresh fruit and vegetables, or sandwich) can help eliminate this problem.

Chronic fatigue is a sign of overtraining and should be prevented by the woman asking herself how she feels in the morning, both from a physical and mental perspective. If she is sore or has a general sense of malaise, she needs to curtail her exercise training intensity or volume.

The use of a written survey tool (e.g., Profile of Mood States, or POMS) can help quantify the degree of mood change and help in decision-making in this regard (McKenzie, 1999).

Exercise Recommendation and Monitoring

It is not feasible to formulate generic exercise recommendations that can routinely be applied across the board for all pregnant women. Individual differences in health status, physical fitness, and previous exercise experience require that the recommendation be customized to meet the specific needs of each person. The exercise program specified is dependent on whether the woman is a novice, an experienced exerciser, or a competitive athlete. A pre-participation screening should be performed and medical clearance obtained prior to engaging in vigorous physical activity. The PARmed-X for Pregnancy (CSEP, 1996) is a thorough screening process recommended to be completed together with the pregnant woman's prenatal health practitioner prior to her participation in a fitness class or other vigorous exercise program. The women who need the most detailed evaluation and recommendations are beginners just starting an exercise program and competitive athletes wanting to compete during their pregnancies. Those healthy women who were already active prior to becoming pregnant do not need to change their activity unless they experience problems or they want to consider changing their program to include activities that carry an increased risk.

Contraindications to exercise should be ruled out by the health-care provider and precautions discussed (see Table 2). For beginners to exercise, a start date should be determined based on their previous exercise experience and pregnancy history. Beginners should participate in the decision on whether to begin exercising during or following the first trimester. Ideally, sedentary women should start exercising at least 6 weeks prior to planned conception. Establishing a level of moderate to high physical fitness prior to conception may be the optimum way to start a pregnancy. Failing this, a novice should begin gradually with 3 exercise sessions a week for up to 20 minutes at low-moderate intensity (ACSM, 1995). Walking or swimming programs are good suggestions for those just starting out.

Exercise Testing Procedures. In situations where exercise testing is performed, a decision as to what should

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be included needs to be made. Testing may be indicated if the exercise to be undertaken is vigorous, there is a marked increase in intensity, or a mother has suspected health risks related to the level of exercise she desires. Maximal graded exercise tests (a multi-staged stress test usually performed on a treadmill or cycle ergometer beginning at a low intensity and gradually increasing in intensity until the subject is exhausted) used to determine one's cardiorespiratory endurance are not routinely performed due to a potentially high-risk/benefit ratio. Submaximal tests (intensity usually not to exceed 85% of predicted heart rate maximum), although less accurate in predicting aerobic capacity, can provide some basis for fitness comparisons since submaximal workloads have been shown to produce a lower heart rate (HR) in trained pregnant women compared with sedentary pregnant women. The HR during exercise tests should be compared with ratings of perceived exertion (RPE) and the woman educated on the use of the RPE scale (Borg, 1982). The HR reserve and the magnitude of HR change to increased power output are also blunted during pregnancy, making prescription based on HR alone less valid. Any exercise test on the treadmill or cycle ergometer should not exceed 10-12 minutes in order to reduce the time the fetus is at risk for reduced blood flow and to avoid hyperthermia. A 3- to 5-minute warm up should precede the test, and an adequate cool down should be incorporated to avoid blood pooling and hypotension. Maximal testing of strength and flexibility is not recommended due to relaxed ligaments from gestational hormones and a possibly increased risk of injury; submaximal testing is fine. Stretching prior to testing should be emphasized to ensure that the chest, lower back, hip flexors and adductors, and hamstrings are not too tight.

Body composition can be determined using anthropometric measures. Skinfolding techniques can be used to provide good estimates of maternal adiposity (Paxton et al., 1998). Underwater weighing and bioelectrical impedance (a low-voltage current is passed through the

body between placed electrodes; a greater resistance to electrical flow indicates more adipose tissue compared to lean) methods of body fat assessment are questionable due to altered body fluid volumes. A recent report by an expert work group convened on maternal weight gain recommends that health care professionals promote strategies to help women stay within recommended weight gain ranges (Sutor, 1997). They recommend that future research identify more completely the contribution of pregnancy weight gain to body composition, body fat distribution, and the long-term risk of maternal overweight and obesity, and interventions for weight management. Any counseling or intervention should also include suggestions for improving the quality of the diet. It is beyond the scope of this paper to address specific nutrition concerns during the childbirth year, but a useful publication is *Nutrition During Pregnancy and Lactation: An Implementation Guide* (Institute of Medicine, 1992). For further information on exercise testing, the reader is referred to research by Wolfe (1993) and Clapp (1998).

Exercise Monitoring. Monitoring should first involve the maternal health-care provider's recommendations based on routine, ongoing examinations to assure health. The provider will also suggest any general limits for exercise. The prenatal fitness professional routinely inquires of the woman if she feels well, hot, hungry, dizzy, or weak before, during, and after exercise. The provider must also ask if the doctor or midwife had any concerns during the last checkup, particularly in regard to the baby's growth or the mother's weight gain and fat deposition pattern. If the baby falls off the expected growth curve, then exercise intensity and/or duration may need to be moderated. The woman should be accumulating fat around the abdomen, hips, and thighs. To monitor the risk of dehydration, body weight should occasionally be checked before and after activity, especially after increases in training volume. For women whose medical condition or activity level suggests that close monitoring is advisable, an evaluation every 2 to 6 weeks should take place in the exercise laboratory. Glucose should be checked with a portable glucose monitor and rectal temperature should be monitored. Dietary intake should be checked to make sure adequate calories are being consumed.

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General Guidelines to Manage Exercises during Pregnancy. A number of general suggestions are available for women exercising during pregnancy:

- To avoid hypoglycemia and ensure adequate nutrition for fetal growth and development, a pregnant woman should not fast more than 4 hours.
- A woman should not eat within an hour before exercising in order to avoid an insulin reaction.
- During endurance exercise lasting longer than 30 minutes, a carbohydrate drink should be consumed during the activity period and a light meal eaten following completion of the exercise session.
- A water bottle should be the active pregnant woman's constant companion, especially during early pregnancy when blood volume is likely to be low.
- Appropriate clothing should be worn for the ambient conditions.
- If the temperature is much above 80 degrees, or if it is very humid outside, exercise should be confined to air-conditioned rooms.
- Fetal heart rate (FHR) should occasionally be checked before, during, and after exercise using a portable doppler ultrasound monitor (see Table 5).
- Alternating hard training days with easy days is suggested, along with insuring adequate rest, which includes naps during the day if fatigued.
- Proper footwear, biomechanics, technique, and an even floor or ground surface are crucial in avoiding overuse syndrome injuries (repetitive microtrauma usually from weight-bearing activities resulting in musculoskeletal conditions such as shin splints, stress fractures, and other prolonged aggravations of the knee or foot).

While risks of exercise may be minimal for the healthy woman experiencing a normal singleton pregnancy, she

Table 5 Fetal Response to Mother's Exercise During Pregnancy*

The most common fetal response to strenuous, maternal aerobic exercise is a moderate increase in fetal heart rate (FHR). A normal rise is between 5-25 beats/minute followed by a gradual return to pre-exercise baseline HR within 20-30 minutes following exercise. A normal resting FHR is around 140 ± 20 beats/minute. If FHR rises more than 25 beats/minute during exercise, it could mean the session was too stressful.

On rare occasions, fetal bradycardia (a drop in FHR of more than 20 b/min) has occurred during exercise or in the immediate recovery phase. Abnormal FHR responses may be due to mild, transient fetal hypoxia. The clinical significance of these occurrences is not known, but no correlation has been shown between them and fetal health outcomes (Clapp, Little, & Capeless, 1993).

After exercise the baby should move several times within the next 30 minutes. If any abnormal responses occur, the exercise intensity and duration should be cut back by 10%-25%. If there is any question, the health care provider should be consulted. The health fitness professional must watch for signs of overtraining—chronic fatigue and loss of motivation are the best indications for the need to reduce the severity of the exercise.

*Adapted from Clapp (1998), Wolfe (1993), and Wolfe et al. (1994).

should understand the rationale behind any restrictions and be a willing partner in any monitoring and adhering to safe exercise guidelines. Therefore, teaching principles and education should be viewed as an integral part of the comprehensive activity program. The Appendix provides details useful in planning and conducting a prenatal exercise program.

Exercise During the Postpartum Period

The desire to lose weight and tone muscles in the postpartum period is common for most women. Those women who were inactive throughout pregnancy frequently want to begin a program at this time. Weight reduction can be difficult for anyone at anytime, but a mother who is trying to return to her prepregnancy weight is also challenged with additional stresses of increased child care commitments, less rest and sleep, household responsibilities, and possibly returning to work outside the home. To be successful, she will need the support and understanding of her family, friends, employer, and medical caregiver. Perinatal health professionals should be able to provide sound fitness and weight-loss program-

ming advice to women who wish to be active during the busy and exciting, but sometimes complicated, postpartum period. Previous research has demonstrated that maternal weight loss, especially while breastfeeding, can be achieved safely and with no adverse effects through vigorous exercise and sensible dieting (Sampselle, Seng, Yeo, Killion, & Oakley, 1999; Hammer, Babcock, & Fisher, 1996).

Hammer and Hinterman (1998) recently published in this journal an in-depth article that describes exercise and dietary programming to promote maternal health fitness and weight management during the postpartum period. Table 6 provides specific guidelines for postpartum exercise. Other practical sources of information for working out following childbirth may be found in these books: Bing and Colman (1994) and Noble (1995).

Implications for Childbirth Education

Many perinatal education programs include a prenatal exercise class that begins in early- to mid-pregnancy. These classes may be taught by childbirth educators or by others who specialize in prenatal exercise. In either case, it is important for childbirth educators to understand the rationale for and research behind exercise recommendations for pregnant women.

Table 6 Exercise Suggestions During Postpartum*

- If breastfeeding, nurse or collect milk prior to exercise and then nurse at least 1 hour after intense exercise. Also, eat an additional 500 kcals per day to support milk production.
- Ensure good breast support during exercise.
- Drink plenty of fluids.
- Start doing pelvic floor exercises, pelvic tilts, and abdominal tightening exercises within hours after delivery. Begin walking short distances as soon as fatigue from delivery subsides.
- Check for diastasis recti (abdominal muscle separation) and, if present, modify abdominal exercises.
- Practice good posture and lifting techniques since the increased lifting required by new mothers puts them at risk for back injury.
- After 2-6 weeks, with physician approval, more strenuous aerobic and strengthening exercise can be performed. Those who delivered by Cesarean section take longer to recover. Use lochia changes (an increase or reddening of vaginal discharge) as a sign of overdoing it.
- After 1-3 months, a complete, vigorous workout can usually be performed.
- If incontinence is a problem despite faithful practice of Kegel exercises, referral for early evaluation and behavioral management is warranted instead of waiting for resolution.

*Adapted from Hammer and Hintermann (1998).

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Appendix Guidelines for Offering Prenatal Aerobic Conditioning, Strength Training, and Flexibility Exercises

Aerobic Conditioning

- **Type.** Preference should be given to activities that use large muscle groups and develop cardiovascular fitness. Some experts recommend nonweight-bearing activities, such as cycling and swimming, but this may be too restrictive for many women. Weight-bearing exercise such as walking or jogging may be the most convenient mode of exercise for many. Low-impact aerobics classes, fitness machines (such as step and ski simulators), cycling, water activities in cool water, and most recreational activities are fine too (see Table 4 for activities associated with increased risk). The exercise leader should not be too prescriptive. Correct principles should be taught and the woman permitted to choose activities that she enjoys. However, she should not scuba dive past 12-16 feet deep, nor should she participate in high-altitude hiking or ski-touring due to increased hypoxic risk. Depending on her skill level, a pregnant woman should be very careful and, perhaps, avoid sports and activities that could cause falls (e.g., horseback riding, skating, water and downhill skiing, and contact sports) to minimize potential injuries.
- **Frequency of Activity.** Generally, 3-5 days/week is recommended (ACSM, 1995). A novice should start with 3 days and gradually build up to 5 days per week, if desired. If more intense workouts are performed, they should be alternated with easy days to facilitate recovery.
- **Intensity.** Age-predicted HR targets are less reliable during pregnancy. However, the fit pregnant woman exercising at a HR of between 135-150 beats/minute is generally regarded as safe. The beginner should start at a HR between 120-135 beats/minute and, if she desires, gradually work up to a higher level. RPE is probably the best method of determining intensity during exercise with a recommended intensity range of between 12-14. The “talk test” is another safe subjective criteria to use. In late pregnancy, as the gravid uterus presses against the diaphragm, shortness of breath can occur making it more difficult to talk and lowering the intensity at which exercise occurs. Competitors can exercise at a level that exceeds this, but they are also in the group for whom closer monitoring is suggested.
- **Duration.** 15-30 minutes/day is required for basic fitness adaptations to occur. Lower intensity activities may be performed for extended periods for those who desire more exercise. A well-trained woman can exercise continuously up to 60 minutes/day if she experiences no adverse symptoms.
- **Progression.** This aspect depends on whether or not the woman was previously active or is just beginning a program. It also depends on whether or not she is an athlete who still wants to compete or just to prevent the loss of fitness. For those who have been training prior to pregnancy, the goal should be to maintain health and fitness rather than increase competitive performance. For those beginning an exercise program, intensity and/or duration can be increased by 5% and/or 5 minutes/week respectively. The best time to make progress is during the second trimester when maternal-fetal risks are lowest (Stevenson, 1997b). The interested reader can find more information on aerobic conditioning in Clapp (1998), Noble (1995), and Pirie (1987).

Strength Training

Using light to moderate resistance, machine or even free-weight lifting exercises are effective to pursue during pregnancy if one adheres to safety principles. The use of weight machines rather than free weights alleviates the fear of maternal-fetal injury by dropping a weight. Careful “spotting” is necessary if free weights are used. Strength workouts should include exercises for at least the following muscle groups: abdominals, back extensors, gluteals, rhomboids, trapezius, external hip rotators, quadriceps, and pelvic floor. Strength development of these muscles is especially helpful in performing daily living activities during pregnancy (e.g., lifting, carrying out household chores, and climbing stairs). Strength training also helps prevent disuse atrophy, which can result in spinal and postural problems as the uterus and

breasts enlarge (i.e., forward head syndrome with kyphosis, rounded shoulders, and lordosis). Finally, strength training assists with certain active positions taken during labor (i.e., during first and second stages where standing and draping against a partner or table or assuming a modified squat may be more comfortable and advisable than the supine position) (Horsely, 1998).

One or more sets of 8-12 repetitions for 8-10 different major muscle groups are recommended (ACSM, 1995). Performing resistance exercise 2 or 3 times a week is a good goal. The Valsalva maneuver should be avoided by breathing properly—exhaling while lifting and inhaling when returning the weight load to its original position. Benefits include improved posture and less daily fatigue. After the fourth month of pregnancy, strength or stretching exercises in the supine position may need to be avoided since they could reduce blood return through a compressed vena cava and even constrict blood flow through the abdominal aorta. However, conditions vary with the individual since only 5% of pregnant women show a reduced cardiac output even in late pregnancy (Kerr, 1965). Many women can do supine floor exercises through the seventh month of pregnancy without any hypotensive symptoms such as dizziness or abnormal fetal heart rate. A prudent guideline to follow for women who prefer to continue to perform supine exercise after the fourth month (such as abdominal strengthening, certain weight lifting exercise, or stretching) is to limit the time on the back to one minute or less. Additional information on strengthening exercises can be found in Noble (1995) and, particularly for the pregnant athlete, in Pirie (1987).

Pelvic floor exercises, frequently referred to as “Kegel’s,” should be included as part of a pregnant woman’s daily routine. The pelvic floor performs a vital function in urinary and fecal control, support of the pelvic organs (avoiding prolapse), and sexual satisfaction of both partners. Also, awareness and control of these muscles may be helpful in order for a woman to relax them during the second stage of labor (Horsely, 1997). Usually at around the fifth month, an increase in pressure around the pelvic area is felt as the uterus grows. Urinary incontinence then becomes a common problem during late pregnancy and the postpartum period. Pelvic muscle strength was increased and symptoms of incontinence decreased during these vulnerable times in a group of pregnant women randomly assigned to perform pelvic floor exercise compared with a control group (Sampselle, Miller, Mims, Delancey, Ashton-Miller, & Antonakos, 1998). The muscles that need to be strengthened are those that, when contracted, will interrupt the flow of urine, although the practice of intentionally stopping urine flow is no longer recommended due to possible infection risk and urine retention (Wallace, 1994). Instead, correctly taught pelvic floor exercises should be practiced at other times. A considerable portion of women are unable to do isolated pelvic floor muscle contractions given only verbal instructions, and many may mistakenly substitute a Valsalva maneuver (Bump, Hurt, Fantl, & Wyman, 1991). Proper assistance from the perinatal educator can prove invaluable in this regard. Several variations of this exercise can be done, but 10 repetitions per set repeated several times through the day are recommended. The woman should learn how to relax the pelvic floor, which will enable easier parturition. Specific pelvic floor exercises can be found in Hammer & Hinterman (1998), Noble (1993), Bump et al. (1991), and Cammu and Van Nyler (1995).

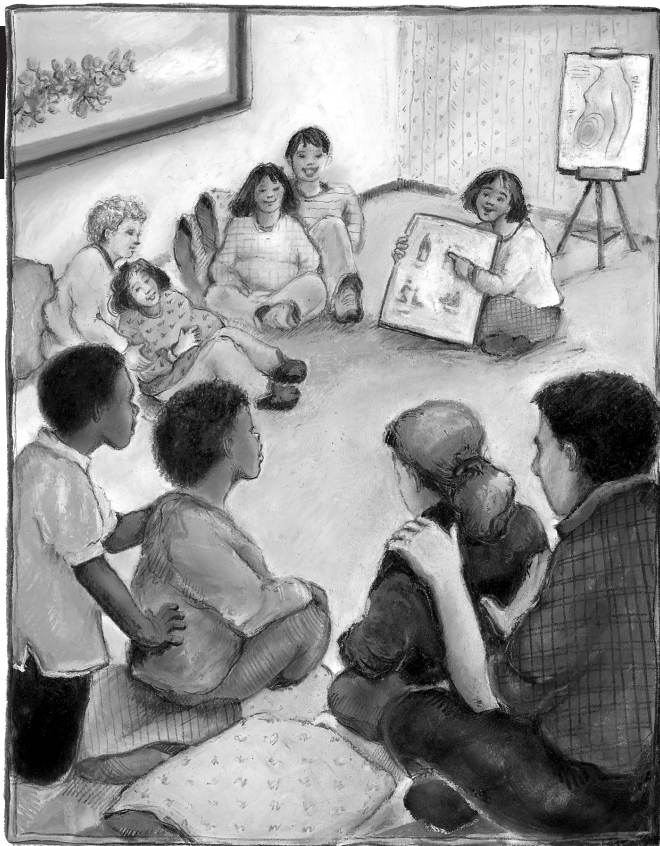
Flexibility

Stretching exercises should be performed as part of the warm-up and the cool-down phases. Static stretches and slow dynamic movements should be included. Breath control and emphasizing relaxation are important. Pectorals, hamstrings, and hip adductors and flexors may need special attention since they have the tendency to become tight. Fear exists that pregnancy hormones will predispose a woman to soft tissue tears if maximal end points are reached; however, no evidence supports this concern. Still, to remain prudent, the woman should not stretch to the point of pain or perform fast, ballistic movements, especially late in pregnancy. In partner-assisted stretches (frequently performed in prenatal classes), the partner must be careful not to push joints into extreme ranges of motion. The reader is referred to Noble (1995) and Pirie and Herman (1995) for further details on stretching exercises.

Warm Up and Cool Down

Warm-up and cool-down exercises are even more important during pregnancy than at other times. The body prepares for exercise during the warm-up phase. Low-intensity activities that use large muscle groups will increase circulation and raise body temperature, thus enhancing neural, connective, cardiac, and skeletal muscle tissue function and theoretically decreasing injury probability. A normal warm-up activity is to perform either general calisthenics or simply the planned aerobic activity at a lower intensity. The onset of perspiration is an indicator of being warmed up. Stretching exercises can follow the warm-up phase to further prepare the tissues for more strenuous activity.

The cool-down phase allows the breathing and heart rate to return slowly to pre-exercise levels and prevents the pooling of blood in the lower extremities. The pulse rate should drop below 100-110 beats/minute prior to stretching before terminating the workout (ACSM, 1995).



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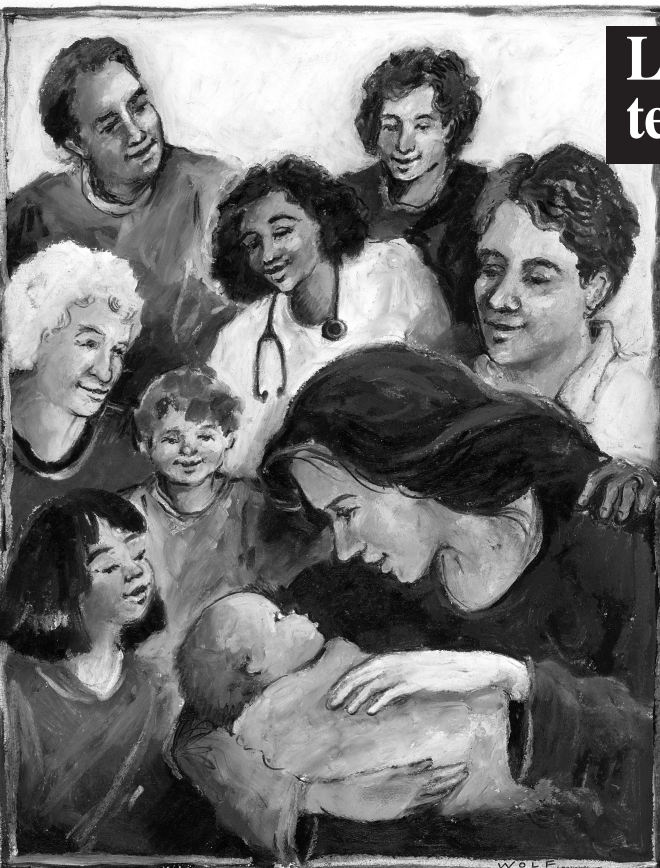
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